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GEOLOGY AND PALÆONTOLOGY.

THE TACONIC SYSTEM IN GEOLOGY.[1]—The existence of a series of stratified rocks in the Appalachian valley, intermediate in age between the older crystalline or primitive schists and the Palæozic rocks of the New York system, was taught by Eaton and main-

[1] Abstract of a paper read before the National Academy of Sciences at Washington, April 18, 1880.

tained by Emmons, whose Taconic system, as first proposed, was later declared by him to consist of an upper division, which he referred to the horizon of the calciferous sandrock of the New York system, and a lower division, the proper Taconic. In this latter was included a great group of quartzites, limestones, and soft crystalline schists, which have since, by different geologists, been assigned to not less than three distinct horizons in the New York system. The grounds of those contradictory opinions have been supposed stratigraphical relations, and also the apparent association with the Taconic limestones of organic remains belonging to these various horizons.

In localities away from the disturbed regions of the Appalachian valley there exists a series of rocks occupying the position assigned by Emmons to his Lower Taconic, and agreeing with this in its essential characters. Such a series is found north-west of the Appalachian region, a little to the north of Lake Ontario, where it rests upon schists like those of the Green mountains, and is unconformably overlaid by the Trenton limestone, and totally distinct from the lower members of the New York system in the adjoining region. Another locality is to the south-east of the Atlantic belt, in southern New Brunswick, where a similar series of several thousand feet of limestones, quartzites and schists occupies a position inferior to the fossiliferous Cambrian (Menevian). In both of these localities the rocks in question correspond closely in volume and in mineralogical characters to the Lower Taconic rocks of the Appalachian valley, with which the speaker believed them to be identical.

Again, Mr. W. O. Crosby has lately described a similar series in the Island of Trinidad, resting on the ancient crystalline rocks and overlaid unconformably by limestones of Trenton age.

We have thus abundant evidence of a great and wide-spread series of rocks, pre-Cambrian in age, and occupying the position assigned by Emmons to the Lower Taconic or Taconian system —which, according to him, extends continously along the Appalachian valley from Vermont to Alabama, and moreover occupies large areas to the south-east of the Blue Ridge, from Virginia to Georgia, constituting, in South Carolina, the Itacolumite series of Lieber.

Within the vast region occupied by these rocks in the great valley, have been found a few small areas of fossiliferous strata, belonging chiefly to the Ordovian (Siluro-Cambrian) or to the Cambrian series; but the characters of the great mass of these rocks are such as to lead to the conclusion that they constitute, as maintained by Emmons, a more ancient series.

To the Taconian rocks belong the peculiar magnetic iron-ores found at Reading, Cornwall, and Dillsburg, Penn., which have been by some geologists regarded as Mesozoic, but were by Rogers assigned to the base of the Palæozoic. To this same

series belong the limonites of the great valley, which occur in clays derived from the sub-aërial decay of the rocks. These rocks, in their unchanged condition, contain beds and masses of siderite and pyrites, the alteration of which *in situ* has given rise to the limonites. In the formation of this from siderite or iron-carbonate, it was pointed out by the speaker that there is a contraction of volume equal to about 20 per cent; to which is due the cellular character of the limonites and their frequent occurrence in the form of geodes.

These older rocks are not without traces of organic life, having yielded in the Appalachian valley the original *Scolithus*, and related markings, besides obscure *Brachiopods;* and in Ontario, besides similar Scolithus like-markings, a form apparently identical with the *Eozoön* of the more ancient gneisses. We may hope to find in the Taconian series a fauna which shall help to fill the wide interval that now divides that of the Eozoic rocks from the Cambrian. We should seek in the study of stratigraphical geology not the breaks dividing groups from each other, so much as the beds of passage which serve to unite all these groups in one great system, remembering that there is no local hiatus which is not somewhere filled up by the continuous process of nature.—*T. Sterry Hunt.*

A FOSSIL PHYLLOPOD CRUSTACEAN FROM THE QUATERNARY CLAYS OF CANADA.—We have received through the kindness of Principal J. W. Dawson, LL.D., of Montreal, a valve in partial preservation, of an Estheria quite unlike any existing American form. The following account of its discovery is from Principal Dawson:

"It was found at Green's creek on the Ottawa river, in nodules in the Post-pliocene clay, holding skeletons of *Mallotus villosus* and other northern fishes, and shells of *Leda (Portlandia) arctica*, *Saxicava rugosa*, &c.; also leaves of Populus, Potamogeton, &c. The deposit is of the age of the Leda clay of the St. Lawrence (middle glacial) and belongs to a period of submergence where in the bay or estuary then representing the Ottawa river, northern marine animals were imbedded in deposits into which was also washed the débris of neighboring land, and of fresh water streams. The climate at the time was colder than at present, and the area of land less, so that if this Estheria still lives, it is most likely to be found in the vicinity of the Arctic coast."

This Estheria is entirely unlike any northern American or European species, differing decidedly from *Estheria morsei* or *E. caldwelli* and *E. clarkii*. It rather approaches *E. jonesii* from Cuba in the form of the shell and style of marking of the valves. It does not resemble closely any of the fossil forms figured in Jones' Monograph of fossil Estheriæ. The markings, however, present some resemblances to *E. middendorfii* Jones, but differs in the want of anastomosing cross wrinkles between the ridges.

One valve and portions of others were preserved; but none of

them show the beaks (umbones), though the form of the remainder of the shell indicates that they were situated nearer the middle of the valve than usual, *i e.*, between the middle and the anterior third of the shell. The shell is deep, probably more so than in *E. jonesii*, though the valves have evidently been flattened and somewhat distorted by pressure, but apparently the head-end was more truncated than in *E. jonesii*, as the edge of the shell and the parallel lines (or ridges) of growth along the head-end are below bent at right angles to the lower edge of the shell. The raised lines of growth are very numerous and near together; they are of nearly the same distance apart above near the beaks as on the lower edge. The very numerous lines of growth are thrown up into high sharp ridges, the edges of which are often rough, finely granulated, and often the valleys between are rugose on the surface. In one or two places a row of papillæ for the insertion of spinules may be seen where the shell has been well preserved, and between many of the lines of growth there are irregular superficial ridges. Length 10 mm.; depth 7.5 mm.

The valve is evidently that of an Estheria, much truncated anteriorly, and with the lines of growth much thicker, higher and closer together than in any North American species known to us, and may prove when better specimens are found, to be allied to the tertiary Siberian *E. middendorfii.*

The species is named in honor of the discoverer, J. W. Dawson, LL.D., who has so persistently and ably investigated the Leda clays of Canada.—*A. S. Packard, Jr.*

Miocene Dogs.—In the Bulletin of the Hayden Survey, Vol. VI, p. 177 (Feb., 1881), I gave a synopsis of the genera and species of this family found in the Lower Miocene formation of the Western Territories. These numbered seven and nineteen respectively. The recovery and discovery of some material since that date, enables me to make the following corrections and additions: (1) The proper dental formula of *Hyænocyon* is I. $\frac{?}{3}$; C. $\frac{1}{1}$; Pm. $\frac{3}{3}$; M. $\frac{1}{1}$. Its reference to the Canidæ is not certain. (2) It seems that the species I named *Icticyon crassivultus* cannot be placed in *Icticyon* on account of an important difference in the dental formula. It must be considered typical of a new genus which I will call *Oligobunis*, and compare its characters with those of *Icticyon* as follows: *Oligobunis*, I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{1}{2}$; an internal tubercle of the inferior sectorial, which has a basin-shaped heel; *Icticyon*, I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{2}{2}$; no internal tubercle of the inferior sectorial, which has a trenchant heel—*E. D. Cope.*

Reinsch's Microscopic Investigations of the Structure of Coal.[1]—Whilst there is a general agreement among geologists that the coal of all geological formations is of vegetable origin,

[1] *Neue Untersuchungen ueber die Microstructur der Steinkohle des Carbon, der Dyas und Trias.* Von Paulus Friedrich Reinsch. Mit 94 lithographirten Tafeln. Leipzig, T. O. Wiegel, 1881.

there have been contentions from time to time, in the literature, as to the mode of accumulation of such immense masses of vegetable material, and as to the species of plants furnishing it. In his book on Chemical Geology, 1861, Dr. Fred Mohr argues forcibly in favor of the hypothesis that the massing together of marine algæ, or seaweeds, in bays by oceanic currents will account for many otherwise inexplicable occurrences of coal beds. This view, however, was unable to gain a foothold against the botanical evidence furnished by the fossil plants so beautifully preserved in the slates overlying the coal beds, and which are terrestrial plants exclusively, belonging to much higher organized families than the algæ. The frequent occurrence, too, of whole fossil forests of Sigillarids and Lepidodendroids, rooting in the underclay and penetrating the coal beds at right angles, are as many evidences for the swamp hypothesis. Thus far no internal evidence had been furnished, that is to say the structure of the coal itself had not been made a part of the argument on either side. This is owing to peculiar mechanical difficulties connected with the preparation of microscopic sections of coal. Thus, whilst many industrious observers have examined sections and noticed the presence of organic structure, no one has ventured to interpret what he saw, botanically, because nothing can be seen distinctly unless the cutting of the section be proceeded with in a certain way. At this point Professor Reinsch steps up with the beautiful work now before us. He tells of his microscopic work upon the metamorphic limestones of the Huronion, *i. e.*, the Eozoön Canadense, the quartz schists and the hornstone concretions of the Silurian limestones of Ohio; and how he then turned his attention upon the coal, and with the previously gained experience, soon obtained such remarkable results, that the apparent hopelessness of getting satisfaction from the serpentinized and silicified structures, was turned into exultation by the carbonized material. Here there could be no more doubts, whether the things seen under the microscope were sedimentary, concretionary or crystalline or organized structures. The results and conclusions of Professor Reinsch's work may be summed up as follows:

1. *Preparation of the Sections.*—A plane cut as in rock and mineral sections, generally is not serviceable; the cut must be made in relief. Thus only the different forms can be brought out, as according to their hardness each form will become more or less transparent, since the softest parts will be worn faster and hence be finally thinner and more transparent than the more resisting forms. Sections parallel to the bedding are made without difficulty. Not so sections at right angle. Much precaution is to be exerted with these. Cut the raw plate with a steel saw 4 mm. thick, 15 mm. square. Make a plane cut as usually in rock sections, but using only the finest emery (polishing emery) or precipitated carbonate of calcium. Then rub the surface gently

in all directions with a cork plate (perfectly soft and no grains) 10 mm. square and moistened with a drop of glycerine. This treatment produces the relief. Frequent examinations must be made under the microscope, to observe the point where the desired transparency has been reached (not less than 0.01 mm.). In some cases as for Trichites and Grammites it is best to warm the raw plate and saturate it with a mixture of wax and paraffine. When attaching the plate to the support, it should neither be heated very long with the balsam nor too short a time; the first excess causing the plate to warp, crack, and inducing a partial alteration of some of the coal constituents; too little boiling causes the plate to detach itself from the support during the process of grinding. Chemical treatment with acids or alkalies is not advisable.

A microscopic image of the condition of things in a coal section may be had by closely inspecting a sharp cut through a compressed ball of hay. Here the innumerable plant individuals are cut in every direction. The different sections of the same plant have often so little in common, that an identification of the species is extremely difficult. This is true of a microscopic coal section, and only the comparison of very many specimens will establish the common characters of the forms. Prof. Reinsch's conclusions are drawn from 1200 perfect sections.

2. The organic forms of the coal consist of Protophytæ. That is, plants without distinct cell structure, with sporadic enclosures of spores and tissue fragments of cryptogamous and still higher plants. The analogous forms of the present time being Bacterium, Vibrio, Asterothrix, Protoleptis, Zoöglœa, etc.

3. These forms constitute seven generic types (thus far) in a lower and higher order.

A. Naked Plasma, forming indefinitely outlined bodies, without indication of an exterior wall.

I. *Racostromidæ.* Plasmatic thalloms, stronger trunks branching into many connected branchlets. Substance uniform, without celluloid structure. (Color in section, brown red to deep purplish red, semi-transparent.)

II. *Trichodidæ.* Trichomic plasma, running into numerous capillary ramifications. Separation of the plasma into two substances indicated.

III. *Grammitoidæ.* Plasmic thalloms composed of a honeycomb web. No cells. Uniform opaque substance.

IV. *Asterophragmidæ.* Plasmatic thalloms resembling Racostromium, but whose substance is connected with radially arranged spheres, composed of centrogranular, polarizing granules.

V. *Blastophragmidæ.* Trichoid plasma forming Trichomata, from whose granular substance polarizing spheres are formed, as in Asterophragmium.

B. The plasma forms definitely outlined bodies with an indication of external wall.

VI. *Plasmidæ.* The thalloid plasma is not yet clearly outlined by an external wall, but is composed of a granular, or fibrillary substance from which primary cells are developed.

VII. *Chroococcidæ.* The plasmatic body has become a cell, surrounded by an external wall not fully developed.

Of these types, fifty-two specific forms are described in the

book, and richly illustrated with admirable drawings, without whose assistance a description is not intelligible.

4. From the great rapidity with which, under proper surroundings, the Bacteria and even the fresh-water Desmids grow and multiply, the considerable thickness of strata which the siliceous cells of the latter accumulate in a few years, there is no longer difficulty in the way of understanding the formation of coal beds now, nor the absence of microscopic structure in all true coals, nor their compactness. For pressure alone is amply sufficient to produce this density. Nor is the difference in chemical composition of various coals now so much astonishing, since this will depend on the composition of the predominating protophytes of the stratum. However, these points are not investigated yet, as indeed the whole study has not advanced beyond the establishment of a few fundamental theses. Professor Reinsch does not expect a rapid acceptation of his views, but he desires stimulating capable observers everywhere, to carry the light of science into this dark field of hereditary beliefs.

In conclusion, we would heartily congratulate Prof. Reinsch for this invigorating contribution to geology, in the prosecution of which upon our vast carboniferous areas, botanists and chemical geologists should join hands.—*George A. König.*

GEOLOGICAL NEWS.—Dr. Alpheus Hyatt has published his researches on the forms of *Planorbis* found in the Tertiary beds of Steinheim. The variations are extraordinary, and furnish important evidence for the evolutionist.——Neumayr and Uhlig publish an extensive and well illustrated paper on the Ammonites of the "Hilsbildungen" of North Germany, in the last number of the *Palæontographica.*——Professor H. A. Nicholson, of Edinburgh, publishes a handsomely illustrated volume on the possibly polypoid group of the *Monticuliporidæ.*——Mr. S. A. Miller has recently described some additional species of the interesting genus *Myelodactylus* Hall.——Professor Cope has published in the Proceedings of the American Philosophical Society, the cuts illustrating the Permian vertebrata described in his Paleontological Bulletin, No. 32. The genera illustrated are *Eryops, Cricotus, Empedias* (= *Empedocles* nom. praeocc.) and *Dimetrodon.*

GEOGRAPHY AND TRAVELS.[1]

IMPORTANT DISCOVERIES IN SOUTH AMERICA.—In the NATURALIST for April, 1879, mention was made of the departure of Dr. Edwin R. Heath, of Wisconsin, from New York, in November, 1878, for a journey of exploration along the Beni and Madre de Dios rivers, in Brazil. He proposed to continue the work of the late Professor Orton, so sadly interrupted by his death. The *Kansas City Review of Science* for April, contains an interesting account of the success of Dr. Heath's expedition. He has ex-

[1] Edited by ELLIS H. YARNALL, Philadelphia.